

Terrain Relative Navigation (TRN)

Completed Technology Project (2016 - 2021)



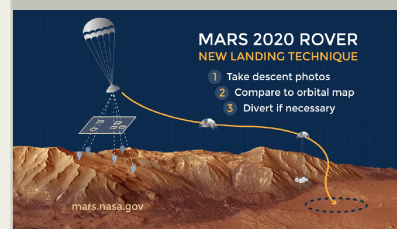
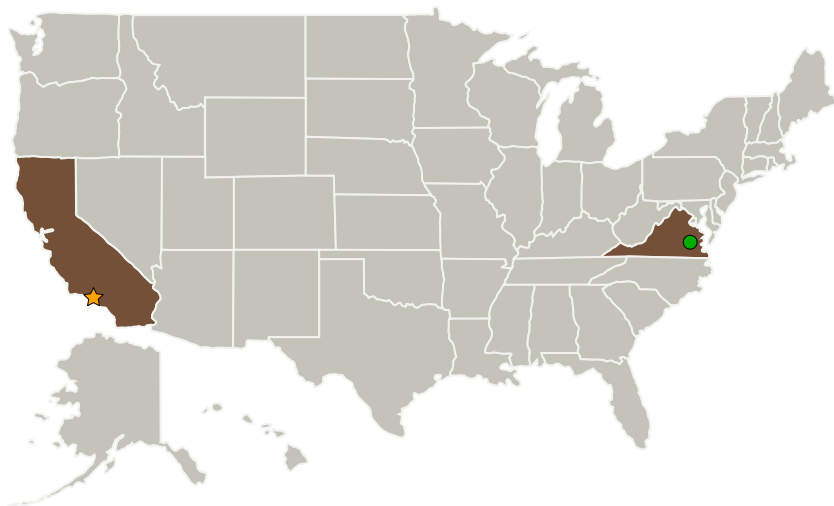
Project Introduction

TRN is a key part of the MARS 2020 Guidance, Navigation, and Control (GNC) subsystem designed to provide the capability to avoid large scale landing hazards during the entry, descent and landing (EDL) phase of the mission. TRN uses images gathered during descent to identify surface features and match them to orbital images to identify where the vehicle is and avoid pre-identified landing hazards. Additionally the technology will allow the vehicle to identify key science targets and land near those targets thus significantly reducing required surface traverse after landing.

Anticipated Benefits

The technology developed under the TRN project will be key to future human and robotic missions by enabling safe access to scientifically compelling landing sites and providing surface processing capability to support surface mobility and autonomy.

Primary U.S. Work Locations and Key Partners



Terrain-Relative Navigation helps us land safely on Mars - especially when the land below is full of hazards like steep slopes and large rocks!

Table of Contents

Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Images	3
Links	3
Project Website:	3
Technology Areas	3
Target Destinations	3
Supported Mission Type	3

Technology Demonstration Missions

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Organizations Performing Work	Role	Type	Location
★ Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Co-Funding Partners	Type	Location
Exploration Capabilities	NASA Program	
Science Mission Directorate(SMD)	NASA Mission Directorate	

Primary U.S. Work Locations	
California	Virginia

Project Transitions

▶ **October 2016:** Project Start

✓ **April 2021:** Closed out

Closeout Summary: Just before 3:00 p.m. CST on February 18, the Perseverance rover successfully touched down in Jezero crater, Mars. Approximately 240 seconds into the entry stage and 7 miles above the surface, the parachute was deployed, followed shortly by jettison of the heat shield to further slow the spacecraft and allowing a new EDL capability — Terrain-Relative Navigation — to get to work. The Terrain-Relative Navigation system used a camera on the bottom of the rover to compare the features on the martian surface to an onboard map to determine its exact trajectory and landing site. The terrain of Jezero crater necessitated little margin for error during landing as it contains steep cliffs, sand, boulders, and craters that can be hazardous to the rover.

Closeout Link: <https://mars.nasa.gov/mars2020/mission/technology/#Terrain-Relative-Navigation>

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Technology Demonstration Missions

Project Management

Program Director:

Trudy F Kortes

Program Manager:

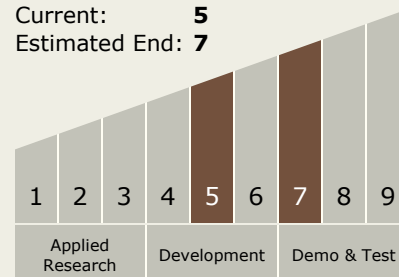
Tawnya P Laughinghouse

Principal Investigator:

George Tahu

Technology Maturity (TRL)

Start: 5
Current: 5
Estimated End: 7

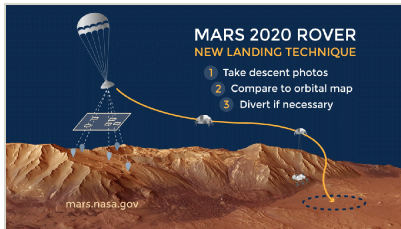


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Images



Terrain Relative Navigation (TRN).gif

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(<https://techport.nasa.gov/image/100911>)

Links

EDL simulation

(<https://mars.nasa.gov/mars2020/timeline/landing/entry-descent-landing/>)

Project Website:

https://www.nasa.gov/mission_pages/tdm/main/index.html#.VQb6XUjJzyE

Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
 - └ TX17.2 Navigation Technologies
 - └ TX17.2.1 Onboard Navigation Algorithms

Target Destinations

Mars, Foundational Knowledge

Supported Mission

Type

Planned Mission (Pull)